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**CONTRIBUTORS**

CHARLES R. BARDEEN, A.B., M.D., Professor of Anatomy, University of Wisconsin
ELIOT R. CLARK, A.B., M.D., Professor of Anatomy, University of Missouri
ALBERT C. EYCLESHYMER, Ph.D., M.D., Professor of Anatomy, University of Illinois
J. F. GUDERNATSCH, Ph.D., Formerly Professor of Anatomy, Cornell University Medical College, New York
IRVING HARDESTY, A.B., Ph.D., Professor of Anatomy, Tulane University of Louisiana
C. M. JACKSON, M.S., M.D., Editor, and Professor of Anatomy, University of Minnesota
DEAN D. LEWIS, M.D., Professor of Surgery, Rush Medical College, Chicago
RICHARD E. SCAMMON, Ph.D., Professor of Anatomy, University of Minnesota
J. PARSONS SCHAEFFER, Ph.D., M.D., Professor of Anatomy, Jefferson Medical College, Philadelphia
H. D. SENIOR, M.B., F.R.C.S., Professor of Anatomy, University and Bellevue Hospital Medical College, New York
G. ELLIOT SMITH, M.A., M.D., F.R.C.P., F.R.S., Professor of Anatomy, University of London
CHARLES R. STOCKARD, Ph.D., D.Sc., Professor of Anatomy, Cornell University Medical School, New York
R. J. TERRY, A.B., M.D., Professor of Anatomy, Washington University, St. Louis, Missouri

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# SCIENCE

FRIDAY, DECEMBER 9, 1921.



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## THE PRESENT SITUATION IN FORESTRY, WITH SPECIAL REFERENCE TO STATE FORESTRY[1]

No nation can prosper or even exist in comfort without wood, without a considerable supply of relatively inexpensive timber. Three years ago our per capita annual consumption of wood was about 300 board feet, exclusive of large quantities used for fuel, paper and a multitude of other purposes. It is extremely difficult for our minds to picture what this means in total volume or amount when multiplied by 110 million, our present population. Each year we remove from our forests or destroy through forest fires about 56 billion board feet of timber large enough to saw into lumber. This almost incomprehensible amount of wood disappears from our forests every year. Much of it we need and use, and can not very well get along without. On the other hand much of it is destroyed by fire. The latter is not only a great immediate economic loss and waste, but also an encroachment on supplies that will be very much needed in the immediate future.

As a nation we have grown to our present stature on a lavish diet of wood. We use more wood than any other nation on earth. Our industries would stop, our very civilization stagnate were we suddenly deprived of our wood supply. Wood the world over is a basic resource. It is almost the first resource to be exploited and utilized in the development of a new country. Moreover, it is the resource that makes possible the utilization of other resources. There is scarcely an industry that can prosper without wood. Agriculture, transportation and commerce as we know them to-day are inconceivable without wood. All of us are daily in contact with wood wrought into some form for our comfort or necessity. From

[1] An address delivered in the School of Citizenship, Yale University, Wednesday, October 26.

morning until night wood in one or another of the diverse forms into which man has shaped it is influencing your life and mine.

If we trace the progress of industrial development in the civilized nations of the earth we are impressed by the apparent fact that:

1. Industrial development proceeds faster in countries when domestic or imported wood is available in considerable quantities.

2. Industrial development becomes arrested when available wood supplies are reduced below the essential needs of industry.

China at one time was well wooded. Prior to the exhaustion of her timber supplies she reached a stage in civilization and economic development beyond that of most other nations. She exhausted her forests centuries ago and has been without wood adequate for her essential needs for many generations. Historians have assigned many reasons for the early arrest in economic progress by the Chinese. It appears, however, that the progressive destruction of her forests far below the point of essential wood needs made the development of other industries impossible or extremely difficult.

Japan, on the other hand, although surpassed in civilization and industry by China during the long period while Chinese wood was available in quantity, has never exhausted her forests and now has wood in abundance. There is every reason to believe if Japan had followed China's example and had devastated and exhausted her forests and made no provision for regrowth, we would hear little of Japan to-day as a world power. Greece, once powerful and prosperous, fell from her high estate centuries ago. She swept the forests from her hills and mountains in attaining her power and in building her civilization and did not make provision for regrowth. She destroyed her forests, she neglected regrowth and lost her place in the sun. She is still without adequate wood for her essential needs. Switzerland, a small nation of mountains and hills, though poor in soil and most other resources upon which the strength of a nation depends, has retained her forests. She still has wood, a basic resource. She is prosperous and forward moving.

The republic of Switzerland, only a little larger than the state of Connecticut, has three million people tilling less than 20 per cent. of the land. Some of her forests were organized as early as 853 A.D. They have been continuously under timber production for more than 1000 years and are more intensively managed and more productive to-day than ever before. The government assumes control over all absolute forest land and the following three requisites are a part of the forest laws:

(*a*) The forests must not be divided in area or broken up by sales.

(*b*) The volume of the cut must be prescribed and the fellings must follow a plan which maintains a growing stock of trees.

(*c*) All areas cut must be promptly restocked.

The forest laws of Switzerland declare that her forest area must not be diminished but the private owner can demand that his forest be bought by the public if he feels unable to manage it under laws which insure its perpetuation. These laws have for their object the maintaining of the forest in area and with stocked stands of growing trees.

England, though a leader among nations in economic and industrial development, has reached her place of eminence in world affairs without maintaining an adequate domestic supply of wood. Great Britain, an island empire, the first sea power of the world, has been able to meet the need of her industries for wood by bringing it from the four ends of the earth. The recent war, however, has shown her the necessity for domestic wood resources and she is now expending millions of pounds in reforestation.

America was blessed with abundance of wood when settlement began early in the seventeenth century. More than half of what is now the United States was covered with virgin forests, composed of a great variety of species, many of which are unexcelled for lumber and other essential products. We have been called a nation of home builders; we have built our homes out of the forest and we have kept them warm with wood cut in the forest. We have been more lavish in the use of wood than any other nation. We have used and destroyed the

wood at hand and thought little of the future. To-day 110 million people in the United States are using wood just as lavishly, just as wastefully as when our country was young. As a nation we have been unable to think in terms of possible timber exhaustion. Three or more centuries of forest devastation, of forest destruction, have given us the habit of thinking of the forest as inexhaustible.

Let us go into the woods and see what we can find. It must be clear to all of us that no matter how large an area of forest land this country holds within her borders, if there are no trees growing thereon we can not look forward to getting wood to build our homes and supply our industries. We must have foresight to see that regrowth or young stands of timber of acceptable species must reclothe forest land after the removal of old timber through lumbering, fire or other causes. Future timber supply to meet the essential needs of this country depends upon one thing and one thing only, namely, adequate regrowth. Somehow, or in some way, this regrowth must be attained.

Since settlement began we have been getting our wood for the most part from virgin forests, namely, from woods that were thousands of years in developing and were never disturbed by man. As a nation we have cut and otherwise destroyed the virgin forests so rapidly, out of our original 822 million acres we now have left only 137 million acres and these for the most part are in the more inaccessible parts of the country, chiefly in the far West. For all this the remnant of our virgin stands are now yielding three fourths of all the saw timber that we consume. At our present rate of cutting and present rate of destruction by fire, it is certain the remainder of our virgin timber will be practically all gone within the life time of people now living. At present we obtain but one fourth of our timber needs from forest land previously cut over or from stands that have grown since the removal of the virgin crop. It must be clear to all of us that with the passage of time more and more of our timber needs must be met from trees grown on forest land that has been previously cut over. It must also be appreciated that in the not distant future all our wood must come from such land because there will be no virgin forest left.

Prohibiting cutting in the remnant of our virgin forests will not give us an adequate future timber supply. We should not be critical of the cutting of virgin timber or for that matter of the cutting of merchantable second growth timber. The wood is needed and is a basic resource in our national progress and industrial development. We should be critical that regrowth, in the form of fully stocked stands of desirable species, does not follow the removal of the old stand by logging, by fire or by any other cause whatsoever, when the removal is from forest land, that is, land better suited for the growth of timber than for other economic uses.

As a nation we have been so remiss in providing for regrowth, for new crops of timber of acceptable species, to take the place of the old, we are certain to suffer a severe timber shortage as the remnant of our virgin timber disappears and we are forced to turn to second growth for a constantly and rapidly increasing percentage of the wood supplies essential for our prosperity and well being.

About 463 million acres of the land area of the United States is classed as forest at the present time, but of this vast area 326 million acres have been culled of their best timber, cut over or burned. For the most part these 326 million acres have been left to chance restocking and only a comparatively small percentage is fully stocked with desirable species. Nearly all of this vast area now bears a more or less fragmentary growth, often of inferior species. On a fourth of the entire area there is no forest growth whatsoever and the land is idle.

What can we expect in the way of future timber supplies from our culled, cut-over and burned forest areas? This is a very important economic question at the present time. Please remember 326 million acres of our present area of forest land culled, cut over or burned, and only 137 million acres of virgin forest remaining, all of which will soon be gone.

Assuming that our area of forest land re-

mains as it is to-day, namely, at 463 million acres, and that we exercise no more foresight in harvesting the remainder of our virgin forest than we have in the past, what can we expect in annual growth when our virgin timber is gone, to supply this great nation with wood? The United States Forest Service estimates the present annual growth on our 326 million acres of burned and exploited forest at approximately 6 billion cubic feet. Assuming that the annual growth on exploited forest land will remain as it is at the present, after we have exploited the remainder of our virgin forests, the total 463 million acres of forest property in the United States will produce an annual growth of approximately 7 1/2 billion cubic feet. This is all that will be produced by growth each year unless we radically change our present forest policy and conscientiously plan for regrowth on a vast scale.

It is a very serious economic situation that we are now using up our forest capital more than four times as fast as we are producing it. In other words the annual growth in our forests is now approximately 6 billion cubic feet while the annual removal of wood from our forests by lumbering, fire and other causes, is over 26 billion cubic feet. We are cutting into our forest capital—the reserve supply, largely in our virgin forests—more than four times as fast as we are growing wood.

It must be evident to all that we can not go on using each year four times as much wood as we grow in a year and do this indefinitely. It must also be evident that our future supply of timber will not be assured until the annual growth of wood on our 463 million acres of forest land is at least as much as what we annually consume.

Without forest management and without serious attention given to regrowth, we grow each year less than one fourth as much wood as we use, but were all our 463 million acres of forest land fully stocked and in different age classes, there is ample evidence to show that the annual growth would be raised to approximately 28 billion cubic feet. In other words, it is possible to produce, through increased growth on our present area of forest property, more than four times as much wood as is now grown. An annual growth of 28 billion cubic feet of wood in the forests of the United States is a goal toward which we should push. It will take a century to place all our forest property under management and to fully stock all our 463 million acres of forest land with acceptable species. An annual growth of 28 billion cubic feet, however, can not be attained until this is done.

Were all our forest land under management and fully stocked, would we be able to use advantageously the amount of timber each year represented in the possible annual growth of 28 billion cubic feet? We are now using and destroying annually approximately 26 billion cubic feet of wood; only a little less than can be grown on our entire area of 463 million acres were it all under a system of management as excellent as that of Central Europe.

Although there appears to be no inherent reason why this nation can not grow yearly as much wood as we now consume, it will not be done and moreover it can not be done without public approval and public support. The raising of the present annual growth in our forests from 6 billion cubic feet to a possible annual growth of 28 billion cubic feet is necessary if we are to be adequately supplied with wood fifty years hence.

As conditions are at present we Americans are faced with the essential fact that we are not only destroying our forest supplies more than four times as fast as we are growing them, but what is of more far-reaching importance we are, through lack of forest organization and management, rapidly using up the productive capacity of our forest lands. Not only is there less and less wood grown each year but more and more forest soil is destroyed each year beyond the power of immediate recovery for the production of wood crops. The investigations of the United States Forest Service show that already 81 million acres, out of our 463 million acres of forest property have been so completely

denuded, they are now idle, and with no immediate prospects of regrowth. This vast area scattered through many states is of no more immediate value to the nation or to the owners than it would be were it in the heart of the Sahara Desert.

The destruction of our timber through lumbering and fires without providing for regrowth and the destruction of the timber-producing power of vast areas of land valuable for no other purpose would not be so important from the standpoint of our future industrial development were it possible to obtain needed wood from beyond our own borders. Can we look to other countries for the enormous amount of wood needed if we permit our forests to fail us through our neglect to obtain regrowth? We can not. Mexico has no more lumber than she needs for her own use. Canada has already made it plain that we can not look to her for lumber supplies in large quantity. The old world requires all the available wood in her forests and tropical America, although with vast resources of hardwoods, has comparatively little that is suited to the needs of the American people. In short, as time goes on we must grow our own wood or go without. Furthermore, we must increase the growing of timber on a vast scale during the next fifty years while we still have virgin forests that remain uncut.

A program for the growing of timber on an adequate scale for our future needs must include:

First, organized fire protection and prevention that will eliminate present losses to young and old stands from forest fires.

Second, the prevention of owners of commercial forests now uncut from destroying, through destructive lumbering, the power of their lands to keep on growing trees.

Third, the reforestation of those parts of our forest area of 463 million acres that have become more or less completely denuded and are now without regrowth or are inadequately stocked.

Fourth, the improvement of existing regrowth and that to be attained in the future by systematic silvicultural operations.

Please remember all of these must be put into operation and continued until all our forest property is subject to them. Even if we begin now, a hundred years, at least, will be required, and the expenditure of vast sums of money, if we finally reach our goal and increase our annual growth from 6 billion cubic feet of wood to 28 billion cubic feet, which measured by present consumption appears essential for our future needs.

Bringing this important question of inadequate forest growth and denuded and imperfectly stocked forest land nearer home, let us look at the state of Connecticut. Any one of a dozen eastern and southern states might be taken as well. Connecticut was originally completely covered with hardwood and softwood forests. From the time of settlement until toward the middle of the last century the state produced more lumber than she used and some was shipped abroad or exported to other states. Since then she has been unable to supply wood for her own essential needs. Constantly increasing quantities are yearly imported from other states and from other countries.

Connecticut was early settled and the land was gradually cleared for agricultural use. Farmers settled on areas of primeval woods and started to carve farms out of the wilderness. The land embraced in the entire state of Connecticut early passed to the ownership of private citizens. The farms were the year-long homes of the people who owned them. Roughly they were composed of agricultural land and forest land. Early in the last century the forest had been cleared from approximately three fourths of the state and the land taken for agriculture and grazing, also a considerable part of the remaining one fourth still bearing forest had been culled of its best timber, or more or less completely cut over. The last remnant of the virgin forest disappeared early in the present century.

Throughout Connecticut, as in most other eastern states, acceptable farm land is interspersed with forest land, that is, with land

that it is unprofitable to attempt to cultivate. The average farm therefore contains both agricultural land and forest land. In the poorer regions of the state, as in parts of Litchfield and Middlesex counties, the larger percentage of the farms is forest land while in Hartford County the larger percentage is agricultural land. Although three quarters of a century or more ago, three fourths of the land of Connecticut had been cleared for agriculture and grazing, much of this cleared land has since been abandoned as fields and pastures and left to return to forest. To-day almost one half of the entire area of the state is classed as forest and the area in productive agriculture has been gradually decreasing for a half century. Why has the area of Connecticut soil used for the production of agricultural crops so persistently and so rapidly fallen off and why has so much land formerly cultivated been permitted to revert to forest?

During the long period of extension of Connecticut agriculture and reduction of the forested areas, the farmers not only tilled their fields in summer, but they worked in the woods in winter. Only a part of their sustenance and profit was derived from their cultivated fields; a considerable part came from the woodland part of their farms. So long as it was possible to find profitable employment during the long winter in their own woodlots, a comfortable living for themselves and families could be derived from their farms, but as soon as the woodlots had been culled of all the best timber and nothing left but cheap fuel wood, it was no longer possible to obtain year-long employment and a comfortable living from the fields alone. For fifty years abandoned Connecticut farms have been in evidence in every county in the state. This abandonment is due to economic pressure forced through the exhaustion and often almost the complete destruction of the productive capacity of the forest land, thus impelling the cleared land alone to support a permanent population which in many cases has been economically impossible.

When the forests of Connecticut were still producing timber in abundance, and agricultural extension had claimed the maximum of Connecticut land, land utilization was at its height. It is a long way from our climax of land utilization in this state of fifty or more years ago to what we find today. Not only have we greatly reduced the area in productive agriculture, but our woods, although increasing in area, have almost completely lost their capacity for yielding timber of large sizes and of high value. They are for the most part stands of sprouts that have been repeatedly culled and cut over until little but inferior fuel wood remains. Although the state now boasts of nearly one half of her total area as forest, its growing capacity is so low and the quality and kinds of timber so inferior, we are forced to send out of the state for 83 per cent. of all saw timber we consume and upon which we yearly pay four to five million dollars in freight alone. Although the forests of the state produce little timber of high grade and of desirable species which command high prices, our woods are filled with inferior species, and low-grade wood chiefly useful for fuel which commands a stumpage price but little higher than that of a half century ago.

While the forests of the state were productive, industries using wood as a raw product were widely distributed through our villages and towns. Every village had its cooper and its wheelwright. Barrels, wagons, tubs, ox-yokes, and all the various articles made from wood and used in a given community, were locally made from home-grown wood in that community.

Wood from local forests helped to support community life and nearby forests provided employment to supplement farm work. Large areas in this state as well as in most other states can not sustain profitable agriculture unless the intermingled areas of forest land are made productive. The development of agriculture and the development of forestry must go forward together wherever part of the land is unsuited for farm crops.

In my opinion an increased population on the land in this state can not be attained and

a more complete land utilization undertaken without employing modern forestry methods in improving forest land which, as you remember, occupies nearly one half of the entire state. If the present forest area of this state were fully stocked and in various age classes, we could, in a very short time, vastly increase our agricultural production, as it would make possible permanent homes on areas that, without nearby woods to afford employment to supplement farm work, is economically impossible.

I sincerely hope that I have been able to impress you with the serious situation which now confronts the American people as to adequate future supplies and for the need of a radical change in forest policy which will make regrowth possible on an extensive scale while we still have virgin supplies for our immediate needs. I sincerely hope that I have been able to impress you with the seriousness of present land problems in states like Connecticut whose agriculture has declined with the removal of the forest.

If you accept my thesis that forestry practise must be established on all of our 463 million acres of forest land, if we are to grow as much wood each year as we will need for the best development of our industrial life, you may well ask how can it be attained. It can never be attained if left to individual effort. Its attainment is primarily a function of government. The forest history of the old world clearly proves that forests are over cut and otherwise destroyed when their control and management are left entirely to private land owners. No nation can perpetuate her forests through wise use unless they are publicly owned or publicly controlled. This nation with four fifths of her forests privately owned, can not possibly attain the regrowth essential in forest renewal unless the public exercise mandatory control and demand of the private land owner that regrowth must follow as a natural consequence of forest exploitation. As a people we must appreciate that our continued prosperity is dependent upon the conservation and wise use of our 463 million acres of forest land. We must also appreciate that the forests thereon are threatened with extinction by the methods under which much of the forest is now handled. We must work for a forest policy which embodies reasonable public regulation of operations in all forests, both public and private. We must work for adequate fire protection, for reforestation, for silvicultural practise and for further acquisition of national, state and communal forests, and all these on a scale which will with certainty insure a future supply of wood to meet the needs of the nation.

The nation, the state, lesser governmental units and the private owners of forest land must cooperate and work together if adequate regrowth to meet the needs of the country is attained. There is need for national legislation and large national appropriations to stimulate cooperation with the states, and provide for fire protection, reforestation, investigation and silvicultural practise. There is need for state legislation which requires of the private owner of forest land that it be kept fully stocked with growing timber and of the state that through tax adjustment, fire protection, and in other ways it make regrowth possible of execution without becoming a financial loss to the private owner. There is need for state legislation providing for local forestry boards comprised of foresters, timber-land owners and timber users to interpret the degree of stocking in their particular locality which will meet the requirements of the law.

As it is in all states to-day, forest property may be taxed for its full sale value. The owner of a growing crop of timber may be taxed fifty times on the crop before ready for harvest and without deriving a single dollar from it until cut. If taxed each year at its full sale value he may pay out more in taxes during the growth of the crop than its entire sale value when cut. This outgrown method of forest taxation must be changed.

Forest crops are inflammable and subject to serious loss by fire. So long as the fire hazard is as great as it is at the present time there is little incentive for private owners of forest land to establish stocked stands of young timber and carry them forward to

maturity. In my judgment it is clearly the duty of the state to adjust taxation on growing stands of timber, provide adequate protection against fire and other destructive agents, instruct the public in silvicultural methods and encourage reforestation by providing planting stock. In return for this assistance by the public, forest land must by law be subject to public regulation which will insure regrowth of acceptable species. Furthermore this public regulation must be in the hands of local boards whose function it is to interpret the requirements of the law in their particular locality.

Constructive state forest legislation is only in its beginning. It is your duty and mine to assist in every way we can in making regrowth possible. First, as American citizens and voters we should work for increased publicly owned forests by the nation, by states, and by local communities. Second, as American citizens and voters we should work for the reasonable public regulation of all forest lands, based upon a system of cooperation between the public and the private owner that will make regrowth possible without, in the long run, entailing financial loss upon the owner. Third, as American citizens and voters we should work for more liberal financial support of the entire forestry movement by both the nation and the state.

J. W. Toumey

The School of Forestry,
Yale University

## OCCURRENCE OF PLEISTOCENE VERTEBRATES IN AN ASPHALT DEPOSIT NEAR McKITTRICK, CALIFORNIA

Pleistocene mammalian remains from asphalt deposits located along the southwestern border of the Great Valley of California have been known since 1865, when Joseph Leidy reported the occurrence of two horse teeth from near Buena Vista Lake and referred the specimens to *Equus occidentalis*. Further remains of this species from the region of Buena Vista Lake were described and figured by Leidy[1] in 1873. Thirty years later J. C. Merriam[2] described a fragmentary lower jaw of the dire wolf, *Ænocyon dirus*, that apparently came from an asphalt bed in Tulare County, California.

The construction of the Taft-McKittrick highway in the petroleum producing belt southwest of Bakersfield has brought to light a fossiliferous bed of asphalt on the southern outskirts of the town of McKittrick. The deposit is apparently located in a narrow zone of asphaltic material shown on the geologic maps[3] of the McKittrick oil region as traversing the foothill region immediately southwest of McKittrick. As mapped by Arnold and Johnson this brea belt is associated areally with Pliocene and Miocene marine beds and is found also in contact with the alluvium of McKittrick Valley.

The occurrence of bones in asphalt near McKittrick was known for many years to the Department of Palæontology of the University of California. Recently John B. Stevens explored the deposit and secured a number of specimens that were kindly presented to the University. During the past summer a field party from the Museum of Palæontology with cooperation and support of the Carnegie Institution of Washington, commenced excavations and made additional collections. Grateful acknowledgment should be made to the Midway Royal Oil Company for permission to excavate and for valuable assistance rendered during the progress of the work.

In the brea deposit near McKittrick a surface stratum of hardened asphaltic material reaches in places a thickness of several feet. This layer contains numerous remains of birds and mammals, apparently represent-

[1] Leidy, J., *Proc. Acad. Nat. Sci. Phila.*, 1865, p. 94; Rept. U. S. Geol. Surv. Terr., pp. 242–244, pl. 33, fig. 1, 1873.

[2] Merriam, J. C., Univ. Calif. Publ. Bull. Dept. Geol., Vol. 3, pp. 288–289, pl. 30, fig. 2, 1903.

[3] Arnold, R., and Johnson, H. R., "Preliminary report on the McKittrick-Sunset Oil Region, Kern and San Luis Obispo Counties, California," pl. 1, U. S. Geol. Surv. Bull. 406, 1910; Pack, R. W., "The Sunset-Midway Oil Field, California, Part I., Geology and Oil Resources," pl. 2, U. S. Geol. Surv. Prof. Paper 116, 1920.

ing the Recent fauna, and overlies the deposit in which Pleistocene vertebrates are found. In excavating the older bed dense accumulations of mammalian remains were encountered. This deposit is in general comparable to these occurring at Rancho La Brea. The exhumed material was, however, not so well preserved as that from the asphalt bed near Los Angeles. This seems due, in a measure, to a prevailing earthy matrix showing somewhat less impregnation by petroleum than in the Rancho La Brea beds.

A small collection of bird remains from the McKittrick deposit was submitted to Dr. L. H. Miller for examination. A preliminary statement has been kindly given by Dr. Miller as follows:

1. Of the ten species thus far determined, six are aquatic or semi-aquatic in habit. With more careful examination to determine exact identity of ducks and waders, this proportion will be increased. Quite the reverse is true of the Rancho La Brea beds.

2. The golden eagle (*Aquila chrysaëtos*) is the most abundant species of land bird. One hawk (*Circus*), one caracara (*Polyborus*), and two falcons (*Falco sparverius* and *F.* near *fuscocerulescens*) are the only other raptors. No owls or vultures appear in the collection.

3. *Parapavo* is not represented. A single quail bone represents the great group of Gallinæ.

4. Shore birds (Limicolæ), so rare in the Rancho La Brea beds, are very abundant here. More specimens of this group are present in the collection of 100 specimens from McKittrick than in all the 50,000 examined from Rancho La Brea.

5. So far as examined there appear no extinct or extra-limital species not found at Rancho La Brea. On the other hand *Teratornis*, *Parapavo*, the great list of condors, vultures, eagles, old world vultures, and owls are thus far lacking.

6. The caracara, the indeterminate falcon, and the two storks, *Ciconia* and *Jabiru*, give the same suggestion of semitropic climate as in the case of Rancho La Brea.

Following is a provisional list of the Pleistocene mammalian fauna known from the McKittrick locality:

*Ænocyon dirus* (Leidy)
*Canis*, near *ochropus* Esch.
*Felis atrox* Leidy
*Felis*, near *daggetti* Merriam
*Arctotherium*, near *simum* Cope
*Mylodon*, sp.
*Equus occidentalis* Leidy
*Antilocapra?*, sp.
*Bison*, sp.
*Camel*, slender limbed form
*Mastodon*, sp.

Several of the mammalian species listed above are known from Rancho La Brea. The dire wolf (*Ænocyon dirus*), the great lion (*Felis atrox*) and the horse (*Equus occidentalis*) also occur in the asphalt beds near Los Angeles. Machaerodont cats have not been recognized at the McKittrick locality. The bear (*Arctotherium*) and the ground sloth (*Mylodon*) occur in both deposits, although the forms represented at McKittrick may be specifically separable from the types found at Rancho La Brea. A camel with slender limbs is certainly distinct from the large *Camelops hesternus* found at Rancho La Brea.

Further collecting at the McKittrick locality will bring out the relationship between this assemblage and the Rancho La Brea fauna. The contrasting features that are recognized at present may result from a geographic separation of the two asphalt deposits. It is probable that the environmental conditions prevailing in the southern portion of the Great Valley of California during the Pleistocene were somewhat unlike those existing in the vicinity of Rancho La Brea. On the other hand, it may be that the faunal differences are to be interpreted as indicating separate stages of the Pleistocene.

JOHN C. MERRIAM,
CHESTER STOCK

## SPECIAL OIL-IMMERSION OBJECTIVES FOR DARK-FIELD MICROSCOPY

DARK-FIELD microscopy was introduced by Joseph Jackson Lister in 1830, and by the Rev. J. B. Reade in 1837. The optical principles were clearly enunciated by F. H. Wenham in 1850–1856, and apparatus substantially as now employed was made and described by him for use with high powers.

In 1877 Dr. James Edmunds constructed special paraboloid condensers for dark-field work with high powers, and insisted upon the necessity of a homogeneous contact of the top of the condenser and the lower face of the microscopic slide, and that the slide should have a thickness corresponding to the focus of the condenser. He recommended this means of study for the body fluids like blood, etc., and for the investigation of living bacteria, whose appearance and actions were described by him in a most striking and picturesque manner.

This information was published in some of the most important and widely distributed English publications (*Transactions of the Royal Society,* 1830, *Trans. Micr. Soc. of London,* and *Quart. Jour. Micr. Science,* 1850–1856; *Jour. Quek. Micr. Club,* and *Month. Micr. Jour.,* 1877; Quekett's "Treatise on the Microscope," 1848–1855, and Carpenter's "The Microscope and its Revelations," 1856).

In spite of this wide publicity the dark-field microscope was used very little either in biology or in medicine. After the discovery in 1905 of the microbe of syphilis, and that it could be demonstrated in the living state with the dark-field microscope, this method of investigation became of vital importance to medical men; and that importance has increased rather than diminished in recent years.

It seems to the writer that it is of equal if not greater importance to the biologist, the physiologist, and the clinician for the examining of the body fluids in health and disease and in the study of living microorganisms, for it brings out with the greatest clearness structures and details of structure invisible in the bright-field microscope. It thus renders the absolute dependence on staining agents after various fixing materials have been used no longer necessary, and serves as a check to the appearances sometimes given by these agents.

Dark-field microscopy has two requirements that must be met for its successful use as was pointed out by the early investigators with it: (1) a very brilliant light is needed. Full sunlight was recommended and remains the most satisfactory light, although the newly devised electric lights like the small arc lamp and the low-voltage head-light lamps serve very well.

(2) The other difficulty that must be overcome is the large aperture of high-power objectives, especially those of the immersion type. This is because the dark-field condensers can not be constructed with high enough aperture to give a dark-field with these high-power objectives, and they are a necessity with the most exacting work.

Two courses were open with the high powers: (*a*) To so construct them that the aperture was low enough to give dark-field effects with the dark-field condensers practicable to construct, and (*b*) To introduce into the high apertured objectives a diaphragm that should cut down the aperture.

The second course was adopted, and reducing diaphragms of all kinds with apertures varying from 0.40 to 0.90 N. A. have been met with; and in a few cases those as low as 0.20 N. A. were found. Not only was there great variation in the aperture of the reducing diaphragms for the oil-immersion objectives, but in many cases they were so constructed that they were liable to get out of place, get out of the optic axis, and prove generally unsatisfactory. Unfortunately also some of the workers in the pathological field were trying to use oil-immersion objectives for dark-field work with no diaphragm at all, and of course could get no dark-field effects.

After a full examination of the different dark-field condensers made in our own country and abroad, it seemed to me that the best all around aperture for the objective to use with them would be about 0.80 N. A. Such an aperture will give a good dark field with all the standard dark-field condensers, and this aperture is great enough to give good resolution on the one hand and the needed brilliancy on the other.

I appealed to the American manufacturers of microscopic objectives to design and

manufacture oil-immersion objectives of this aperture (0.80 N. A.). With such an objective the worker either in biology or in medicine can get good results even without a very profound knowledge of the optical principles involved. He can also go forward with his work with full confidence that the objective being used will give good results, and every worker knows the importance of confidence in his apparatus for successful accomplishment. Finally, during the past summer and autumn the Bausch and Lomb Optical Company of Rochester, N. Y., undertook the manufacture of the desired medium-apertured oil-immersion objectives. The outcome is all that could be asked; and they have been subjected to the most rigid tests in actual practise in the fields in which dark-field work is applied. These objectives are now available, and the writer feels confident that every one using them will feel grateful for the freedom from worry that was always involved in modifying a high-apertured objective for the dark field.

It is only fair to add that no matter how enthusiastic one may be over the possibilities of dark-field microscopy, much more skill is necessary in it than for the ordinary bright-field microscopy. I think that all who have used the dark-field microscope successfully will agree that the ideal plan for an individual or for a laboratory is to have a microscope devoted to this work alone. If then a proper electric light is available, one can proceed to make examination of specimens with the dark-field microscope with the same certainty and rapidity with which examinations are made with the bright field.

It may be stated in passing with reference to these new objectives, that they have certain advantages for ordinary bright-field work. As ordinarily employed the oil-immersion objectives of high aperture (1.40 to 1.20 N. A.), are used in bright-field work without oil-immersion contact between the under surface of the slide and the top of the bright-field condenser. As light of an aperture greater than 1.00 N. A. can not emerge from the condenser into air, it follows that not nearly all of the available aperture is employed. It was believed therefore that these medium-apertured objectives would serve to give practically as good images for histological, embryological and pathological specimens as the high-apertured objectives as ordinarily used. Actual tests proved the correctness of this supposition. Of course when the resolution of fine details is involved the higher aperture is of great importance, but in order to be fully utilized the microscopic slide must be in immersion contact with the top of the condenser.

SIMON H. GAGE

CORNELL UNIVERSITY,
ITHACA, N. Y.

## THE INTERNATIONAL GEOLOGICAL CONGRESS COMMITTEE

AT the twelfth session of the International Geological Congress, the president was instructed to nominate a committee to consider the question of a permanent constitution and to submit a proposal thereon to the next session of the Congress. The following committee was appointed: R. W. Brock, President; J. S. Anderson, C. Barrois, A. Karpinsky, A. Renier, Geo. Otis Smith, G. Steinmann and E. Teitze.

The committee met in the rooms of the Geological Society of London on July 20, 1921. There were present: R. W. Brock, President; A. Renier, Geo. Otis Smith and F. D. Adams (ex-officio member).

At a preliminary conference called to obtain for the guidance of the committee the opinion and advice of a wider and more representative body, the following resolution had been passed:

That this meeting is of opinion that the question of the establishment of an International Geological Union should be considered at the next International Geological Congress, and that it is undesirable that any steps should be taken until the question has been so considered at a full and representative gathering of geologists.

A concise proposal with regard to a constitution to submit for the consideration of the next International Geological Congress was drawn up, the main points of which are as follows:

The purpose of the International Geological Congress, it was stated, is to advance scientific investigations relating to the earth from the point of view

of pure geology as well as of its application to the arts and industries.

The sessions of the Congress are called every three or four years, to continue for about one week. At each session, invitations will be received and the meeting place of the next session determined by the Congress. Excursions constitute an important adjunct to the sessions and every possible facility is given to the members to study the geologic structure of the country where they are assembled, and of its mineral resources, at a minimum expense and under the direction of the most competent guides, with guide books specially prepared which serve the double purpose of guiding the excursionists and of presenting a general review of the geology of the country in which the Congress meets.

Standing committees are organized for the purpose of handling questions of general or international interest demanding international collaboration, and the

Congress may award prizes founded for meritorious work within the domain of geologic research.

The organization should be simple and include:

*A Committee of Organization*, appointed by the host nation, will arrange for that session, its programs and excursions, and its publications.

*Officers.*—At the first general meeting of the session, the Committee of Organization shall submit nominations for President and Secretary of that session, and the Council shall submit nominations for Vice-President, for elections by duly accredited members.

*Council.*—The Congress is administered during its sessions by a Council made up of

1. Members of the Committee of Organization for that session.
2. Presidents of Geological Societies.
3. Directors of national and other large geological surveys.
4. Officers elected by the members of the session.

The Council will prepare the order of the day for the meetings.

*Standing Committees.*—These Committees may be appointed by each Congress to report at the next session, and will be responsible to the Committee of Organization for that next session for the preparation and submission of their reports.

*Membership.*—Invitations to each session of the Congress are issued by the committees representing the host nation, to recognized geological organizations, universities, and to national governments. Membership in the Congress is generally restricted to geologists of national standing.

*Tenure of Office.*—The Committee of Organization and officers shall hold office until the close of that session, or until the next committee of organization is formed, to which the documents and files of the Congress shall be transferred. Subcommittees of the local committee shall continue to function until the publications of the session are issued or other business concluded.

The President of the Congress shall, however, preside at the opening meeting of the next session of the Congress, resigning the chair when his successor is elected.

## SCIENTIFIC EVENTS

### MOLDING SAND RESEARCH

Hundreds of thousands of tons of molding and core sands are used annually in the iron, steel and non-ferrous foundries of America. A little of it is re-used; much more might be. Sands are not always correctly selected for specific purposes. Mixing and other treatment can secure improvement. In what ways can foundry practise as to sands be bettered? What economies can be realized, not only in reduced expenditure for sand, but also in less number of lost castings and higher quality of accepted product?

Last spring, the American Foundrymen's Association decided that thorough study of this subject would be profitable and asked the cooperation of the American Institute of Mining and Metallurgical Engineers. The Institute referred this request to the Division of Engineering of the National Research Council, of which it is a member. Through joint action with the division a valuable digest of the literature has been made by Professor Robert E. Kennedy, of the University of Illinois, and a large committee of foundrymen, engineers and scientific men has been selected, under the general direction of President W. R. Bean, of the Foundrymen's Association and the chairman of the division.

This committee on molding sand research has just been organized with the following officers and executive committee:

Chairman: R. A. Bull, consulting engineer, Sewickley, Pa.

Secretary: Robert E. Kennedy, assistant secretary of the American Foundrymen's Association, Urbana, Illinois.

W. R. Bean, president of the American Foundrymen's Association, Naugatuck, Conn.

Henry B. Hanley, metallurgist and chemist, New London, Conn.

Jesse L. Jones, metallurgist of the Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

Professor Henry Ries, Department of Geology, Cornell University, Ithaca, New York.

Dr. Bradley Stoughton, consulting engineer, New York City.

Dr. George K. Burgess, chief of the Division of Metallurgy, Bureau of Standards, Washington, D. C.

The committee has thirty-five members, representing the many interests in the use of molding sand.

At a meeting of the executive committee on November 26, in the office of Division of Engineering, Engineering Societies Building, New York City, three subcommittees were appointed to deal (1) with the formulation of standard tests for determining the working properties of molding sand, (2) reclamation of molding sands and greater use of old sands and (3) methods of manufacturing synthetic sands. A meeting of the main committee in the Engineering Societies Building, New York, was planned for December 9, to lay out a comprehensive program of research which will include the assigning of the various problems to appropriate laboratories and industrial plants. Some field work will be necessary in connection with these investigations.

The cooperation of men having like interests in Canada and England is assured and invitations have been extended to France and Belgium.

ALFRED D. FLINN
CHAIRMAN OF THE DIVISION OF ENGINEERING,
NATIONAL RESEARCH COUNCIL

## THE BAYARD DOMINICK MARQUESAN EXPEDITION

THE Bayard Dominick Marquesan Expedition for anthropological research has recently returned after fifteen months in Eastern Central Polynesia. The members of the expedition were Dr. E. S. Handy, ethnologist, and Mrs. Handy; and Mr. Ralph Linton, archeologist, members of the staff of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, of Honolulu, T. H. Nine months were devoted to intensive work in the Marquesan Islands. In addition a considerable amount of ethnological and archeological data were obtained in Tahiti.

The ethnological work of the expedition in the Marquesas was approached with the point of view of reconstructing as near an approach as it is now possible to make to a complete and accurate picture of ancient Marquesan culture. In spite of the fact that the population has been reduced to a very low figure as a result of a hundred years of European contact, and that the ancient culture has been subject to the disintegrating influences of missionary teaching and commercial exploitation for eighty years, the results of this survey are reported to be most satisfactory and illuminating with regard to the relationship of the Marquesan culture to the cultures of other Polynesian and extra-Polynesian peoples.

The archeological survey was accomplished with similar success. Its results will be most illuminating to the body of serious students whose attention is turned on the ethnographic problems of the Pacific.

For the physical survey, which rounded out the anthropological investigations as they had originally been planned, a series of two hundred measurements of full-blooded and mixed Marquesans was obtained, accompanied by observations, hair samples and photographs of every individual. Mr. Louis R. Sullivan, of the American Museum of Natural History, is in charge of the compilation and publication of these anthropometric and somatological data. An early presentation of the results of these researches is planned by the Bishop Museum.

It is felt that at last the inhabitants of the Marquesas and their culture have been, so to speak, charted on the scientific map of the world. The work of this expedition represents the first attempt on the part of the scientific

world to make a thorough and organized anthropological study of this interesting and little-known group.

H. E. G.

### LECTURES BY PROFESSOR LORENTZ AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

The following is the provisional outline of the extended course of lectures on "Light and matter" to be delivered by Professor H. A. Lorentz, of Haarlem, Holland, during the winter quarter at the California Institute of Technology at Pasadena:

Older theories of light. Maxwell's theory. Maxwell's equations.
Propagation of light in ponderable bodies.
Huygen's principle.
Interference phenomena. Professor Michelson's methods.
Propagation in a dispersive medium.
Group velocity.
Which is the velocity that is determined by the measurements?
Considerations on (special) relativity.
Fresnel's coefficient.
Momentum, energy and mass.
General considerations on the constitution of electrons, atoms and molecules.
Models of the atom. Thomson, Rutherford, Bohr.
Theory of quanta.
Parson's electron. Lewis's and Langmuir's atom.
Bohr's theory.
Principles of correspondence.
Atoms in stationary states not radiating.
Emission of light. Long trains of waves. Interference with high differences of phase. Structure of spectral lines. Broadening by Doppler effect and other causes.
Scattering of light by molecules.
Dispersion of light.
Anomalous dispersion. Application to solar atmosphere.
Gravitation. Propagation and emission of light in a gravitational field.
Constitution of solid bodies. Atoms held together by electric forces?
Heat motion in crystals.
Magnetism. Theories of diamagnetism and paramagnetism.
Einstein-effect.
Magnetization by rotation.
Quantum theory of the Zeeman effect.
Inverse Zeeman-effect. Older theory. Phenomena observed in the direction inclined to the lines of force. Application to the sun's magnetic field.

In addition to the Lorentz lectures, which will be delivered four times a week from January 4 to March 10, Professor Paul Epstein will give a course on "The origin and significance of the quantum theory."

The California Institute of Technology extends a cordial invitation to investigators in physics, and to teachers in universities, colleges and high schools who are able to do so to attend without charge the Lorentz and Epstein lectures, which will be delivered from 4 to 6 P.M. in the main lecture room of the Norman Bridge Laboratory of Physics.

It is probable that before his return to Holland in April Professor Lorentz will spend a week at the University of Chicago and also at several other universities of the West and Middle West.

### THE SECRETARYSHIP OF SIGMA XI

Professor Henry B. Ward, of the University of Illinois, who has been secretary of Sigma Xi since 1904 and has been in large measure responsible for the national development of the Society, writes in the *Sigma Xi Quarterly:*

Two years ago when the quarter-century of service terminated, I made an especially urgent appeal that the work be passed to someone else. Just at that time, however, the society was emerging from the chaotic condition in which all organizations found themselves after the war, and a new project had just been started which bade fair to arouse interest and develop stronger support than any new plan which the society had developed since the earliest years of its history. It was clear to the president and to the members of the fellowship committee, who were intensely interested in this new movement, that a new man could not possibly take up the work of the secretary's office without embarrassing very seriously, and delaying or perhaps fatally injuring the campaign for the establishment of Sigma Xi fellowships. Accordingly, I reluctantly consented to carry the work for one more term, with the positive understanding that my resignation, to take effect in December, 1921, would be final. Under these circumstances, I may be par-

doned for using so prominent a place in the *Quarterly* to give general notice of this fact. It would seem to me unfortunate that the society should come to the election of officers at the Toronto convention without being precisely informed on the matter and having considered carefully candidates for the place. I should not wish in any way to be charged with undue consideration for the work of the office, but I am sure that I should be false to my obligations to the society at large if I did not indicate the proposed change in adequate time for that part of the membership which is interested in the society to give proper thought to the election of my successor. I am sure that the society can secure a better man for the place, but all of us know that chance nominations on the floor of a convention frequently result in the choice of an individual who for various reasons is unable to assume the responsibilities of the position, even though he may be adequately endowed to discharge its duties with credit to himself and entire satisfaction to the organization.

## SCIENTIFIC NOTES AND NEWS

THE Royal Society has made the following awards: Royal medals to Sir Frank Dyson, astronomer royal, for his researches on the distribution of the stars, and to Dr. F. F. Blackman, for his researches on the gaseous exchange in plants; the Copley medal to Sir Joseph Larmor, for his researches in mathematical physics; the Davy medal to Professor Philippe A. Guye, for his researches in physical chemistry; and the Hughes medal to Professor Niels Bohr, for his researches in theoretical physics.

ACCORDING to press reports, the Nobel prize for chemistry for 1920 has been awarded to Professor Walter Nernst, of Berlin. The prizes for chemistry and physics for 1921 have been reserved for next year. It is said that the prize in medicine will not be awarded this year, and that the candidates that have been considered most eligible are the English physiologist, Sherrington, the Netherlands professor, Magnus, and the two brain specialists, Henschen of Sweden and Vogt of Germany.

THE Jenner Memorial Medal of the Royal Society of Medicine has been awarded to Sir Shirley Forster Murphy in recognition of distinguished work in epidemiologic research.

B. B. GOTTSBERGER has been elected secretary of the Mining and Metallurgical Society of America.

LATHROP E. ROBERTS, of Northampton, Mass., has been appointed to the staff of the Bureau of Mines at Berkeley, California, to take charge of work in physical chemistry.

DR. E. D. BALL has been appointed by Secretary Wallace as the representative of the Department of Agriculture on the research information service of the National Research Council to take the place of Dr. Carl L. Alsberg. The secretary has also named Dr. Frederick B. Power, for many years director of the Wellcome Research Laboratory of London and now in charge of the phytochemical laboratory of the bureau of chemistry, as a representative of the bureau in the division of federal relations in the place of Dr. Alsberg.

PROFESSOR WARREN D. SMITH is remaining in the Philippine Islands another year as chief of the Division of Mines, Bureau of Science, his leave of absence from the University of Oregon having been extended.

WALTER F. CAMERON, formerly deputy chief government geologist, Geological Survey of Queensland, and chairman of the committee on development of oil and gas at Roma, has been appointed mining geologist to the Federated Malay States Government and has commenced his new duties at Ipoh, Kinta District, Perak.

DR. CLEMENS PIRQUET, professor of pediatrics in the University of Vienna, will deliver the third Harvey Society Lecture at the New York Academy of Medicine, on December 17. His subject will be "Nutrition treatment of tuberculosis in childhood."

DR. H. H. LOVE, of Cornell University, has returned to Ithaca, having spent a week each at the Kansas Agricultural College and the Iowa Agricultural College, where a series of lectures were given on the probable error and its relation to experimental results.

The regular lecture at the Johns Hopkins University School of Hygiene and Public Health was given on November 28 by Dr. S. Josephine Baker, director of the Bureau of Child Hygiene, Department of Health, New York, who spoke on "The place of child hygiene in a public health program."

Professor J. H. Mathews, director of the course in chemistry at the University of Wisconsin, lectured before the department of chemistry at Oberlin College, on November 30, on the subjects: "A general survey of photochemistry" and "Color photography." The following evening he spoke before the Cleveland Section of the American Chemical Society on the subject: "Photochemistry and some of its research problems."

The ninety-sixth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Professor J. A. Fleming, F.R.S., on "Electric waves and wireless telephony."

John D. Rockefeller has provided funds for the purchase of the birthplace of Pasteur at Dôle in the Jura. It will be transformed into a museum in which will probably be housed an extensive medical and surgical library, with the authentic documents of Pasteur.

The memorial tablet to the late Lord Rayleigh was unveiled in the north transept of Westminster Abbey on November 30. It is placed between the memorials to Sir Humphry Davy and Dr. Thomas Young.

Dr. Sheridan Delépine, professor of public health and bacteriology and director of the public health laboratory, University of Manchester, died on November 13 at the age of sixty-six years.

Word has been received from Russia of the death on January 2, 1921, at the age of eighty-one years, of Dimitri Konstantinovitch Tschernoff, eminent for his work on the metallography of iron.

The annual meeting of the Society of Economic Geologists will be held in conjunction with the annual meeting of the Geological Society of America at Amherst College from December 28 to 30.

Formal organization of the American Association of Textile Chemists and Colorists was completed at a meeting held in the Engineers' Club at Boston on November 3. Professor Louis A. Olney, of the Lowell Textile School, was elected president.

The Institution of Rubber Industry held its first meeting in the lecture hall of the Royal Society of Arts on October 19, when Mr. J. H. C. Brooking delivered a presidential address.

An International Congress of Maternal and Child Welfare will be held in Paris, July 6 to 8, 1922.

At a meeting of the British Optical Society held on October 13, the resolution passed early in 1915 suspending certain members, subjects of countries then at war with Great Britain, was revoked.

Steps have been taken to organize the engineers of the British Empire on the lines pursued by the Federated American Engineering Societies.

Beginning with the January issue, the *Journal of Orthopedic Surgery*, the official organ of the American Orthopedic Association and of the British Orthopedic Association, has announced that the publication will change from a monthly to a quarterly publication.

Astronomical journals report that early in 1920 following a call sent out by leading German men of science, an Einstein fund was raised. The purpose of the fund is to test the relativity theory experimentally and to make possible the development in Germany of its astrophysical consequences. Sufficient funds were obtained, thanks to the Ministry and Germany Industry, to undertake the construction of a tower-telescope and a physical laboratory.

Professor William Herbert Hobbs, now making a geological reconnaissance in charge of the Osborn Expedition from the University

of Michigan, has reached Manila after six weeks spent in examining the Bonin, Marianne and Caroline Islands in the western Pacific Ocean. Until he reached Yap on September 11, he was traveling as the guest of the Japanese Navy Department. At Yap the U. S. gunboat *Bittern* was placed at his disposal and the Pelews and scattered islands to the southwest were visited. He sailed on the *Bittern* on October 3 for a 4000-mile cruise along the great Sumatra mountain arc and through the Nicobar and Andaman islands to Rangoon, Burmah. He will then proceed to Europe to lecture at the Univesities of Delft and Utrecht, during the spring semester.

## UNIVERSITY AND EDUCATIONAL NEWS

THE *Journal* of the American Medical Association states that the University of Colorado is waging an active campaign to raise the remaining $200,000 necessary to insure the erection of the new medical school and state hospital. Toward the $1,500,000 which the project will cost, the General Education Board has pledged $700,000 and the state has appropriated $600,000, both sums contingent upon the raising of the $200,000 balance by the university. An effort will be made to obtain one dollar from each of 200,000 citizens of Colorado.

DR. ELIHU THOMSON, chief consulting engineer of the General Electric Company, has again been appointed acting president of the Massachusetts Institute of Technology, a post which he filled after the death of Dr. Richard C. Maclaurin in January, 1920, and will continue until a successor to President Nichols is named. The educational affairs of the institute will continue to be directed by a faculty administrative committee consisting of Professor Henry P. Talbot, head of the department of chemistry and acting dean; Professor Edward F. Miller, head of the department of mechanical engineering and chairman of the faculty, and Professor Edwin B. Wilson, head of the department of physics.

ELIOT BLACKWELDER, A.B., Ph.D. (Chicago), will become professor of geology at Stanford University next year, succeeding Dr. Bailey Willis, who will retire in accordance with the provision by which professors of Stanford become emeritus at the age of sixty-five. Professor Blackwelder is now lecturing at Harvard, filling the place of Professor Daly, who is absent on leave in South Africa.

E. H. WELLS, who has conducted special geological investigations for the Chino Copper Company, has been elected president of the New Mexico State School of Mines at Socorro.

DR. E. EUGENE BARKER, formerly assistant professor of plant breeding in Cornell University and more recently of the Insular Government Service, Las Piedras, Porto Rico, has become associate professor of botany, with particular reference to genetics, in the University of Georgia.

C. W. WATSON, a graduate of the Yale Forest School in 1920, has been called to the School of Forestry, University of Idaho, as instructor in forestry. Mr. Watson spent the past year in study abroad under a traveling fellowship in forestry granted by the American-Scandinavian Foundation.

MR. STANLEY WYATT, investigator to the Industrial Fatigue Research Board in England, has been appointed lecturer in psychology at the University of Manchester.

COL. SIR GERALD LENOX-CONYNGHAM, F.R.S., has been appointed fellow and prelector in geodesy at Trinity College, Cambridge.

## DISCUSSION AND CORRESPONDENCE

### AN ENGLISH TRANSLATION OF HELMHOLTZ'S "OPTIK"

TO THE EDITOR OF SCIENCE: Many readers of SCIENCE will be glad to know that the council of the Optical Society has appointed a committee to make arrangements for bringing out an English translation of Helmholtz's great work on physiological optics.

The first edition of the "Handbuch der physiologischen Optik" was published in 1866, more than half a century ago; and the fact that this epoch-making work, which remains to-day the most original treatise on physiolog-

ical optics, has never been translated into English, is a reproach to both Great Britain and America. To make its valuable contents accessible to those who do not find it easy or convenient to read a foreign language will be conferring a boon on many scientific investigators in the vast and expanding territory which this book was originally intended to cover.

Incidentally, the proposed English edition will be a memorial of the hundredth anniversary of the birth of Hermann von Helmholtz, whose influence on modern scientific thought in nearly every direction has perhaps been as widespread and permanent as that of any of his great contemporaries in the nineteenth century.

It is estimated that the cost of translating, editing, and publishing this memorial volume (or volumes) will be $5,000 or more. It is particularly desired that every individual who is interested in the success of this project and in the advancement of the science of light and vision in this country will have an opportunity of contributing towards it.

Contributions, no matter how small, may be sent to Adolph Lomb, Esq., treasurer of the Optical Society of America, care of Bausch & Lomb Optical Company, Rochester, New York. Make cheques payable to "Adolph Lomb, Treasurer."

Any one subscribing as much as $15 will receive a copy of the complete work when it is issued.

James P. C. Southall,
*President, Optical Society of America*
Department of Physics,
Columbia University,
November 28, 1921

## THE AMERICAN SOCIETY OF NATURALISTS

The thirty-ninth meeting of the American Society of Naturalists, as has been noted in Science, is to be held in Toronto on December 29 and 30, with two symposiums of unusual interest—one on genetics and variation, by the zoologists, the other on orthogenesis, in which Henderson, Osborn, Bateson and others will take part.

It is interesting to recall that for the first three years the society was under a paleontologist, Alfred Hyatt; for the two succeeding years under a zoologist, Grove K. Gilbert; then for two years under a comparative anatomist, Harrison Allen. Then in turn the society was presided over by the botanist Goodale, the physiologist Martin, the geologist Rice, the paleontologist Osborn, and a succession of paleontologists and zoologists until 1902, when the psychologist Cattell presided, since which time it has been chiefly under the guidance of zoologists.

The keynote to the success of the Society of Naturalists was the discovery that a more representative body of scientific men can be assembled at a winter meeting than at a summer session. This society has proved to be the mother of societies, because from its broad original organization have gone forth the six national American societies of Geology, Anatomy, Physiology, Botany, Zoology, and Paleontology, all holding winter meetings in various parts of the United States, from the eastern seaboard to Chicago. The zoologists alone cling to the mother Society of Naturalists and hold their meetings in the same time and place.

Of the founders of the Naturalists in the year 1883 there now survive the following: Libbey, Osborn, Scott, Rice and Clarke, the latter, Professor Samuel F. Clarke of Williamstown, being one of the first to answer the call.

Henry Fairfield Osborn

## THE PROGRAM OF THE SECTION OF BOTANY FOR THE TORONTO MEETING

Arrangements have been completed to hold the Section G program on Wednesday afternoon, December 28. Since this program will be of interest to others than the members of this Section the speakers are given below.

Address of the Retiring Vice-President, Dr. Rodney H. True, "The physiological significance of calcium for higher green plants."

*Symposium on "The Species Concept"*

From the viewpoint of the systematist: Dr. Charles F. Millspaugh.

From the viewpoint of a geneticist: Dr. George H. Shull.

From the viewpoint of a morphologist: Dr. R. A. Harper.

From the viewpoint of a bacteriologist and physiologist: Dr. Guilford B. Reed.

From the viewpoint of a pathologist: Dr. E. C. Stakman.

The address of the retiring vice-president will be thirty minutes in length, and each speaker in the symposium has agreed to limit his paper to fifteen minutes. This should allow considerable time for discussion.

ROBERT B. WYLIE,
*Secretary*

## THE TWENTIETH INTERNATIONAL CONGRESS OF AMERICANISTS

THE Twentieth International Congress of Americanists, which was to be held in Rio de Janeiro in 1921 but had to be postponed, will be held definitely from August 20 to 30, 1922, in connection with the celebration by Brazil of its first century of independence.

The organizing committee of the congress announces a rich and attractive program, and in view of the importance of Brazil to American Anthropology it is hoped that a special effort will be made by Americanists in this country to attend the congress, or at least to become members. Application for membership, with the dues of $5, may be sent directly to the Secretary of the coming Congress, Sr. Domingos Sergio de Carvalho, Praça 15 de Novembro N. 101, Rio de Janeiro, Brazil; or to the writer.

ALEŠ HRDLIČKA
*Sec. Gen. XIXth I. C. A.*

U. S. NATIONAL MUSEUM,
December 3, 1921

## FOSSIL MAN FROM RHODESIA

THE British press has just announced the discovery of a fossil human skull from northern Rhodesia that may prove to be epoch-making. It was found in the "Bone Cave" at Broken Hill mine, and bids fair to be of the first importance in its bearing on the physical characters of fossil man. The cranium is practically complete and in a perfect state of preservation; the lower jaw was not recovered. Judging from the newspaper half-tones, the cranium is of a more lowly type than any Neandertal cranium yet discovered; it remains to be seen after a full report has been published whether we may not have here a new species of *Homo* about midway between *Pithecanthropus erectus* and the *Homo neandertalensis.*

The face is intact; the prognathism of the upper jaw is extremely accentuated, this being possible partly because of the unusual maxillary height between the anterior nasal spine and the alveolar margin. The nasal bridge is fairly prominent, a character which has recently come to be recognized as belonging to the Neandertal race.

The brow ridges are more pronounced than in any other known fossil human skull. The cranial height and breadth are correspondingly small, pointing to a comparatively low cranial capacity.

This precious relic is at the British Museum, South Kensington. It will be examined by Dr. A. Smith Woodward and Professors Arthur Keith and Elliott Smith, to whom science is so much indebted for their reports on the Piltdown remains; the result of their study of the cranium from the cave at Broken Hill mine will be awaited with intense interest. If the efforts to find the lower jaw should be rewarded, they may result in throwing new light on the Piltdown paradox.

GEORGE GRANT MACCURDY
DIRECTOR, AMERICAN SCHOOL IN FRANCE FOR PREHISTORIC STUDIES

## SCIENTIFIC BOOKS

*Physiology and Biochemistry in Modern Medicine.* By J. J. R. MACLEOD. 3d edition. St. Louis, C. V. Mosby Co., 1920. Price $10.

The third edition of this interesting textbook has been largely revised and partly rewritten. The changes are uniformly improvements, and the whole book is well written and filled with important methods and facts which are interestingly discussed. Dr. Macleod describes the advances in the

medical sciences, particularly in their bearing upon clinical medicine and human physiology. This point of view is most important and far too often neglected in our American schools of medicine, where the medical sciences and clinics are so thoroughly dissociated. The book should continue to be of general interest to the medical profession as it is of nearly equal value to medical students and to our practising physicians.

It is somewhat unfortunate that the publishing has been made so elaborate. If there were fewer colored illustrations and fewer plates the price of the book could probably have been markedly reduced without a corresponding reduction of its instructive value.

J. C. Aub

Harvard Medical School

*Triassic Fishes from Spitzbergen.* By Erik A:Son Stensiö. Upsala, 1921.

This is one of the most important paleontological memoirs which has appeared in recent years. It represents an attempt to distinguish fossil fishes as organisms, rather than as horizon markers. The geological aspects of the question are, however, thoroughly discussed.

Stensiö is a student of Professor C. Wiman of Upsala, whose contributions during the last few years have interested paleontologists in the fauna of ancient Spitzbergen. Wiman has sent or led expeditions into Spitzbergen since 1908, and on the basis of the material thus assembled the present writer Stensiö has based his account.

The quarto, representing Part I. of Stensiö's studies, consists of 307 pages of printed matter, 35 plates and 90 figures in the text. The presswork coming from Vienna is excellent. The plates represent photographic reproductions of the fossils, with Stensiö's interpretations of the anatomy lettered in white ink in the photographs. The results are especially pleasing and easy of reference.

Elasmobranchs, dipnoans, crossopterygians and three families of Actinopterygii constitute the fauna and Stensiö has described and interpreted his findings in a very excellent manner. Especially interesting are his accounts of the sensory canals of the head; the relationship of the crossopterygians and the tetrapods and the correlations of the primordial ossifications of the head of these primitive forms. It is a grateful relief to find taxonomy in the background. Nomenclature often absorbs more space than is needful.

Roy L. Moodie

University of Illinois,
Department of Anatomy,
Chicago

## SPECIAL ARTICLES

### INHIBITORY EFFECT OF DERMAL SECRETION OF THE SEA-URCHIN UPON THE FERTILIZABILITY OF THE EGG

In the early part of September of this year (1921), while working in the Marine Biological Laboratory at Woods Hole, Mass.,[1] I happened to find a striking fact that the eggs of *Arbacia punctulata* obtained through the genital pores, as most commonly practised,[2] did not develop at all, whereas those taken out from inside the shell developed normally. The results of a few but repeated experiments carried out with regard to this peculiar phenomenon may be given summarily as follows:

The eggs which escaped through the genital pores of opened sea-urchins, and were then transferred to clean sea-water in finger bowls, but subjected to no subsequent washing, were seen attracting spermatozoa but no fertilization occurred. These eggs were later washed repeatedly with clean sea-water at various intervals. If simply washed they never developed. But at a fresh insemination these washed eggs began to develop; thus, for example, the eggs washed and inseminated after standing for 50 hours in room temperature were found still capable of developing into normal and healthy

[1] My hearty thanks are due to Professor E. B. Wilson for the privilege of the use of a Columbia University table in the Marine Biological Laboratory, and to Professor F. R. Lillie, director, and other members of the staff of the said laboratory for every facility for my work. Further, to Professor E. G. Conklin, who has kindly criticized and corrected the manuscript, I express my sincere thanks.

[2] See F. R. Lillie, *Biol. Bull.*, XXVIII., 4, 1915, p. 231.

plutei. Of those which had stood for more than 57 hours, however, only a very few reached the four-cell stage, no further development taking place.

The eggs taken out from inside the shell, on the other hand, showed invariably a high fertilizability, even when much of the "perivisceral fluid" ("blood") had been mixed in water and no washing followed. After more than 28 hours' standing in room temperature, and without subsequent washing, they could be fertilized and they developed into plutei, while among those which had stood for more than 47 hours very few could segment and reach the gastrula stage.[3]

The substance, which inhibits the fertilization and which probably can, to some extent, thus prolong the life of the unfertilized egg, has been found to come from the surface of the body of the sea-urchin. This I may call "dermal secretion." If a sea-urchin is opened and inverted over a dry dish for a while some dull yellowish fluid collects in the dish. When the eggs taken out from inside the shell were inseminated *in* this "dermal secretion," no matter whether the latter had been obtained from male or female animals, fertilization was found inhibited in varying degrees according to the concentration of the fluid. The dermal secretion, when present in a 5 per cent. concentration in sea-water, was found sufficient to inhibit all the eggs from fertilization. In 2.5 per cent. solution about 10 per cent. of the eggs fertilized, and in 1 per cent. solution about 50 per cent. of the eggs developed. When present in less than 0.5 per cent. concentration practically every egg could be fertilized.

If, however, the eggs were treated with a strong solution of this substance *after* fertilization no injurious effect was found on the early development as late as the pluteous stage. The activity of the spermatozoa also does not seem to change in this fluid.

The dermal secretion thus obtained from *Arbacia* has some inhibitory action also on the eggs of the sand-dollar, *Echinarachnius parma*, though in a lower degree. In a 15 per cent. solution of this fluid in sea-water none of the sand-dollar eggs were found fertilized, in a 10 per cent. solution about 1 per cent. of the eggs developed, and in a 5 per cent. solution about 20 per cent. of the eggs developed.

Through the kindness of Dr. H. C. van der Heyde the substance in question was shown to contain uric acid. From lack of sufficient time I was unable to see if uric acid alone dissolved in sea-water would exhibit the same action upon the egg as the dermal secretion does.

The same substance could also be obtained in some other ways: for example, by placing an *intact* sea-urchin on a dish for a while, no matter which side down, after being washed with fresh water, or by irritating the animal with the sharp point of a glass needle instead of treating with fresh water. On the other hand, sea-water in which some scraped pieces of skin, tube-feet, spines, etc., had been soaked for some time showed very little inhibitory effect upon the fertilizability of the egg.

According to Lillie[4] the perivisceral fluid of *Arbacia inhibits* the fertilizability of the egg, whereas the dermal secretion *protects* the egg from the inhibitory action of the former. I have found that the perivisceral fluid had very weak inhibitory action upon the fertilizability of the egg; thus in a 50 per cent. solution of the same in sea-water about 5 per cent. of the eggs fertilized, and even in a 75 per cent. solution about 1 per cent. of the eggs could be fertilized. Although it may seem quite contrary to Lillie's conclusions, my results rather confirm his view that the inhibitory action of the perivisceral fluid increases during the period when sexual elements are ripe. Lillie's experiments were mostly made in July, when the gonads of *Arbacia* are quite active, while the breeding season comes nearly to an end early in September, when my material was obtained.

It is well known that among Echinoderms, especially Holothurians, there are several species in which the eggs are fertilized and develop inside the mother's body-cavity. In such cases it seems highly improbable that a

[3] As to the longevity of the unfertilized egg of *Arbacia* see A. J. Goldfarb, *Biol. Bull.*, XXXIV., 6, 1918, pp. 393–5; and E. N. Harvey, *Biol. Bull.*, XXVII., 5, 1914, p. 238.

[4] *Jour. Exper. Zool.*, XVI., 4, 1914, pp. 570–7.

strong inhibitory action of the perivisceral fluid upon fertilization should occur at the breeding season. As to the action of the dermal secretion there seems to be hardly any biological significance, since under natural conditions neither egg nor sperm encounters such a high concentration of the secretion as suffices to inhibit fertilization.

Having been engaged in other work, I could not carry out this series of experiments more fully and accurately. But, as I shall not have further opportunity of dealing with this Atlantic species, I have here ventured to communicate this incomplete note, simply with the hope that it may lead to further research on the seasonal changes in the effects of the "dermal secretion" and the "perivisceral fluid" of the sea-urchin upon the fertilizability of the egg.

Hiroshi Ohshima

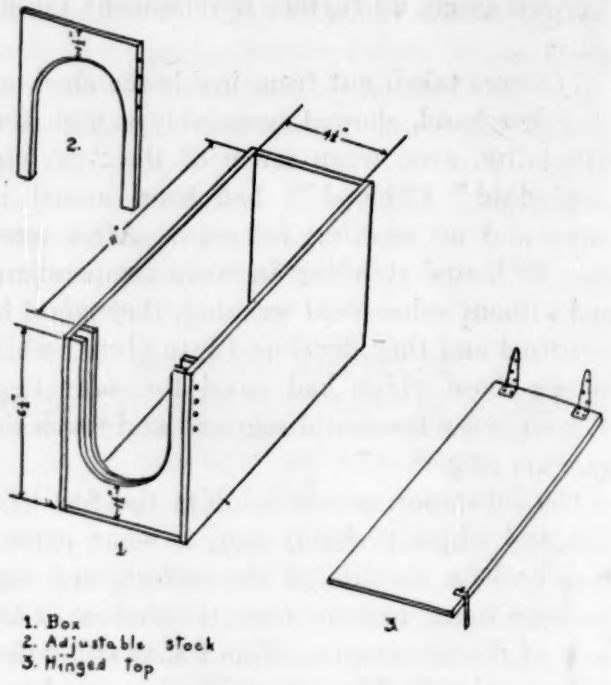
Princeton University

## SIMPLE METHOD OF BLEEDING RABBITS

The simplest method of obtaining rabbit's blood, when more than a few drops are necessary, is that of bleeding from the median artery of the ear. This vessel stands out prominently and is easy of entrance, if the animal is full grown. As much blood can be taken by this method as directly from the heart, and either a syringe may be used, or a cannula only, with a tube to receive the fluid.

The chief advantage of bleeding from this vessel is that small quantities of blood (3 c.c. to 5 c.c.) may be obtained at frequent intervals (daily, if necessary), each point of entry being successively nearer the base of the ear. Ten or more cubic centimeters may be obtained just as easily.

It is occasionally found that even when the needle seems to be safely within the artery, a good flow does not follow. This is sometimes caused by a plug of skin blocking the passage of the blood, but more often it will be found that there are two smaller arteries in place of the single larger one, with a consequently smaller flow in each. Animals which have the single vessel should for this reason be selected. In general, the larger the vessel, the greater is the ease of obtaining blood. A sharp needle is essential, because, due to the thickness and toughness of the arterial




Cage for Bleeding Rabbits

walls, a somewhat dull point will almost invariably pass around the vessel rather than into it. A small needle is best because of the smaller puncture it makes, and the consequently greater ease of stopping the blood after withdrawal. A 21- to 23-gauge needle has been found by the writer to be most satisfactory.

Little trouble is experienced in stopping the flow upon withdrawal of the cannula, usually no more than following withdrawal from a vein. Potassium alum will very quickly stop the bleeding where it will not do so naturally.

The marginal ear vein may also be used in the same way, though it is difficult to obtain more than a cubic centimeter or two therefrom on account of the lower pressure and decreased flow in the veins. The needle must, of course, in all cases be inserted opposite to the direction of the blood flow.

White rabbits, or rabbits with white ears, are much the most suitable sort for this work for obvious reasons. Injections into and bleedings from ear vessels are greatly facilitated by placing an electric light below the ear in such a position as to make the ear translucent. If alcohol is applied on a bit of ab-

sorbent cotton, the double purpose is served of stimulation of the vessels, causing them to dilate, and of plastering down the hair upon the skin, making the veins and arteries more visible. When the needle is withdrawn the alcohol must be well wiped off before the wound will close. Sometimes when an attempt to enter the median artery is for any reason unsuccessful, the blood will be seen to leave the vessel entirely and remain so for a considerable time, due to contraction of the arterial wall which was probably pricked by the needle. Vigorous rubbing, however, will bring the normal circulation back.

Shaving or sterilizing the ear is unnecessary when it is not desired to preserve the blood for more than immediate use. Several hundred injections and bleedings during the past year or two have shown no ill effects whatever. Rabbits apparently rival avian forms in their resistance to infection. Numerous subcutaneous and intraperitoneal injections without shaving or sterilizing the body surface have not shown a single infection.

A very useful sort of cage, designed by Mr. George H. Bisnop for use in this laboratory, makes it simple for one to perform injections and bleedings alone. A box about eleven inches long, four and a half wide, and six and a half deep (inside measurements), has a stock at the front end, the upper half of which operates in a slot, and which may be fastened so as to allow an opening of any desired size, through which the animal's head and neck protrude. A hinged top prevents kicking up behind. Rabbits take very quietly to this temporary confinement once they are placed inside the box, and are not then able to jump and misdirect the needle so easily as when one is attempting to hold the animal. This cage is here illustrated.

GEORGE F. FORSTER

ZOOLOGICAL LABORATORY,
UNIVERSITY OF WISCONSIN

## ADSORPTION BY SOIL COLLOIDS

(PRELIMINARY PAPER)

FOR some time we have been working on the adsorption of soil colloids. We believed that this problem could best be solved by preparing these soil colloids separately in the purest possible condition, and then trying each colloid with the nine following respective salts: potassium nitrate, potassium sulphate, potassium acid phosphate, calcium nitrate, calcium sulphate, calcium acid phosphate, magnesium nitrate, magnesium sulphate, magnesium acid phosphate.

The individual salts have been tried on silica, aluminium, and iron gels, and the humus is now in the process of preparation. We have worked on the adsorption of each ion separately. A few results are given to show the trend of the work.

ADSORPTION BY SILICA GEL

| Conc. | Mg. of Ca Adsorbed per Gram of Gel | Mg. of $PO_4$ Adsorbed per Gram of Gel |
|---|---|---|
| N/10 | — 0.013 | 0.358 |
| N/20 | — 0.034 | 0.114 |
| N/40 | 0.032 | 0.037 |
| N/400 | 0.023 | 0.045 |

ADSORPTION BY IRON GEL

| Conc. | Mg. of Mg. Adsorbed per Gram of Gel | Mg. of $SO_4$ Adsorbed per Gram of Gel |
|---|---|---|
| N | 9.7 | 31.9 |
| N/5 | 8.0 | 30.7 |
| N/10 | 5.7 | 28.3 |
| N/20 | 4.3 | 23.2 |

ADSORPTION OF ALUMINIUM GEL

| Conc. | Mg. of $P_2O_5$ Adsorbed per Gram of Gel in 1 Week | 2 Weeks | 4 Weeks | 6 Weeks |
|---|---|---|---|---|
| N/10 | 261.0 | 291.5 | 338.0 | 385.5 |
| N/20 | 221.5 | 256.7 | 281.0 | 317.0 |
| N/40 | 186.3 | 191.1 | 197.3 | 210.5 |

There was less than the equivalent amount of calcium adsorbed at the various concentrations.

ADSORPTION OF SILICA GEL AT VARIOUS $P_H$ VALUES

| $P_h$ Value | Mg. of K Adsorbed per Gram of Gel |
|---|---|
| 3.888 | — 0.68 |
| 6.086 | 1.74 |
| 7.692 | 6.56 |
| 9.501 | 9.62 |

We have also varied hydrogen ion concentration and followed the adsorption curves for the respective ions with the idea of show-

ing some relation between the acidity of the soil and adsorption. This work is giving most interesting results.

Many of these results speak for themselves, but a discussion together with a full report of all results is being published elsewhere.

Neil E. Gordon,
R. C. Wiley,
E. B. Starky,
A. L. Flenner,
D. C. Lichtenwalner
University of Maryland

## THE AMERICAN CHEMICAL SOCIETY.

(*Continued*)

*Luminescence of parabromophenyl magnesium bromide and related compounds:* W. V. Evans and R. T. Rufford.

*A simplified titrating hydrogen electrode and its use in a plant laboratory:* Felix A. Elliott. The hydrogen electrode previously described by the author has been modified for use in titrations. It has been possible to meet the three important conditions of (1) working in a hydrogen atmosphere, (2) efficient and quick mixture of the solution being titrated with the acid, alkali or other solution, and (3) eliminating the contact potential and at the same time maintaining a constant volume of the solution under investigation, without undue complications in the design and without mechanical agitation. The internal resistance of the cell has been kept very low, thus insuring ample sensibility with the more rugged types of measuring instruments. The apparatus is portable. When fitted with platinized platinum electrodes this cell may be used to determine the content of lime and magnesia in limestone, the amount of acid or alkali in various plant liquors, examples being given. With bright platinum electrodes the cell may be used for such titrations as I with sodium thiosulphate, Fe with sodium dichromate and other titrations involving similar reactions with a change in the charge on one of the ionic species in solutions.

*High frequency ozone production:* F. O. Anderegg. To eliminate the dielectric, which is the greatest weakness with commercial ozonizers, advantage was taken of the fact that it is impossible to maintain a high frequency arc. An aluminium tube 5 x 190 cm. with a concentric wire was used for the discharge. Current was supplied up to half an ampere and 7000 volts at about a million and a half cycles frequency by a small Tesla coil which was designed so as to give the best discharge with the tube used. The highest yields were secured with a rather large wire provided with numerous small points so that the discharge should be made up of many brushes. The ozonized air contained but small amounts of nitrous oxides although on raising the voltage till the discharge was filled with sparks about 0.02 per cent. was obtained. Numerous curves have been worked out showing the relationships between the different variables which are usually similar to those obtained in low frequency ozone production. Maximum concentration was 15 gram per cubic meter. The greatest efficiency obtained was 17 gram per kilowatt hour which in view of the wasteful method of producing the high frequency current is encouraging.

*The reaction between tungsten and hydrocarbon vapors:* Saul Dushman.

*The activity of ions in mixed electrolytes:* C. E. Ruby, T. W. Bartram and Y. L. Yeh. The electromotive-force of cells of the type $H_2$ (1 atm.), HCl ($c_1$) + MCl ($c_2$), AgCl, Ag were measured, in which MCl was, in the two sets of experiments, KCl and NaCl respectively, and the sum of the weight-normal concentrations ($c_1 + c_2$), was held constant in each set of measurements, $c_1$ being varied ten-thousand-fold. Four sets of measurements were made, employing the values of .2, and 1.0 weight-normal for the sum of $c_1$ and $c_2$. The results obtained in these experiments are interpreted in the light of the theory of independent ion-activity.

*The atomic structure: Upon the subtlety of directed particle motion hang all the properties of matter:* H. K. Kipper. By our theory we postulate that: Light is a wave motion of the particles of the ether. Electricity is a helical or screw motion of the particles of the ether (whether atomic or unorganized). Magnetism is a compensated helical or screw motion of particles. Gravity is a function of rotatory motion. Chemical affinity or valency is based on the forces derived from the specific groups of electrons. Solution affinity is based on the forces derived from all groups—that is, such forces taken as a field. All atomic forces are mechanically or mathematically derivable and interpretable from motions of particles in themselves representing simply energy and matter.

*The cryoscopy of boron trifluoride solutions: VI: System with methyl chloride:* Albert F. O. Germann and Marion Cleaveland. P. F. G. Boullay

pointed out, early in the nineteenth century, that ethyl chloride prepared by the method of Dumas and Peligot contains ethyl ether as an impurity. In a paper presented at the last meeting of this Society (see SCIENCE, 53, 582 (1921)), we showed that methyl chloride prepared by the above method (that is from salt, sulfuric acid and methyl alcohol) could not readily be separated from methyl ether which it contains as impurity, and that the presence of methyl ether can be detected by addition of boron trifluoride, which forms the molecular compound $(CH_3)_2O.BF_3$, boiling at 126° C., and remaining as a slightly volatile residue after evaporation of the excess of either gaseous constituent. At the present time, methyl chloride prepared by chlorination of natural gas is available and a sample was obtained through Roessler and Hasslacher. This sample appeared to contain methane, which is somewhat soluble in liquid methyl chloride. A large sample was collected and fractionally distilled five times, after which it distilled at a uniform pressure. Tested by addition of boron trifluoride, the product was completely volatile, showing that the sample was free from methyl ether. The freezing point curve obtained shows a sharp eutectic at 30 per cent. of methyl chloride, where the freezing point was about 137 degrees below zero. There is no indication of the formation of a compound between methyl chloride and boron trifluoride.

*The application of a differential thermometer in ebullioscopy:* ALAN W. C. MENZIES AND SYDNEY L. WRIGHT, JR. The differential thermometer, perhaps 12 cm. long, is extremely simple but of novel type, consisting essentially of a stout glass U-tube containing only water and its vapor, and measures the difference in temperature between the solution and the pure solvent. Both limbs of the thermometer are located in the vapor phase; one of them is laved continually with the solution by means of a Cottrell pump, while the other is laved only by condensed solvent. The apparatus uses neither corks nor stopcocks, is rather insensitive to draughts and to changes in heating, and is unaffected by barometric fluctuation. Results are consistent to one half of one per cent.

*The decolorizing action of boneblack:* CLAUDE H. HALL, JR. The author has repeated and confirmed the work of Patterson. By extraction of hydrochloric acid washed boneblack with sulfuric acid an extremely active decolorizing agent may be prepared. By precipitating this compound on wood charcoal, or other porous substances, a material identical in chemical action with boneblack is obtained. This is the final link in the chain of evidence proving that the decolorizing action of boneblack is due to certain nitrogeneous compounds, the empirical formula and some of the properties of which are described in the previous reference.

*Effect of electrostatic potential on the activity of a catalytic surface:* A. S. RICHARDSON.

*The selenides of ammonium:* C. R. MCCROSKY AND A. J. KING. Pure dry $NH_3$ and $H_2Se$ were admitted to a special weighing tube, free from oxygen. White crystals form when $H_2Se$ is in excess—analyzing from 76 per cent.[1] to 80 per cent. Se, corresponding closely to $NH_4HSe$. This salt dissociates without melting at 100° to 120°. When $NH_3$ is in excess and the temperature of the tube is kept at from 20° to 30°, a liquid forms, practically colorless. (The heat of formation of $NH_4HSe$ is great enough to prevent the formation of the liquid unless the tube is cooled to room temperature.) The analysis of this liquid shows Se 68 per cent. agreeing with the theoretical for $(NH_4)_2Se$. It freezes at approximately 10° and decomposes at 30° to 40° leaving the white crystals of the hydroselenide. Bineau (1838) claims that $(NH_4)_2Se$ is a white solid, also that $NH_4HSe$ is a white solid. Lehner and Smith (1898) prepared a dark-colored crystalline solid from water solution, which corresponded to $(NH_4)_2Se$. Further definite data are lacking in the literature.

*The correlation of compound formation and ionization in solutions:* JAMES KENDALL AND PAUL M. GROSS. The complete specific conductivity-composition curves for 14 systems of the types: acid-ester, acid-ketone, acid-acid and acid-base have been determined. The conductivities of mixtures of the above types are, in general, considerably in excess of those of the pure components, and increase uniformly with increasing diversity in chemical character of these components. The results obtained have been correlated with those derived from freezing-point measurements upon similar systems, and the validity of the fundamental connection between compound formation and ionization in solutions, postulated in previous articles, has been confirmed.

*The prediction of solubility in polar solutions:* JAMES KENDALL, ARTHUR W. DAVIDSON AND HOWARD ADLER. The influence of compound formation between solvent and solute on the degree of

[1] Errors in the method, found later, in all probability account for the low values. These errors were overcome in later determinations.

solubility is critically discussed. It is shown that: (*a*) for a *fixed* solute in a series of *different* solvents, increasing solubility and increasing compound formation proceed in parallel; (*b*) for a series of *different* solutes of high melting-point in a *fixed* solvent, solubility and compound formation also proceed in parallel at low temperatures. Salts of a very weak base exhibit increasing hydrate formation and increasing solubility in water as the acid radical X diverges from OH; salts of a very weak acid show the same behavior as R diverges from H. The increase in the solubility of a difficultly soluble salt in water on addition of a second salt containing a common ion, due to complex salt formation, is dependent upon the diversity of the variable radicals. The extension of these rules to non-aqueous solutions and their importance in analytical chemistry are noted.

*The complete analysis of an insoluble silicate with a single fusion:* F. P. Dunnington. Fuse the powdered silicate with six parts of lithium carbonate in a gold crucible. The melt is dissolved in dilute acid, evaporated, heated and the silica separated as usual. To the solution of chlorides add ammonia, etc. To remove alumina, iron and manganese, precipitate lime as oxalate; magnesia by ammonium phosphate and then, with little calcium chloride and ammonium carbonate remove all excess of phosphoric oxide; evaporate filtrate, volatilize ammonium salts. The residue is digested in a mixture of absolute alcohol and ether, which readily dissolves the lithium chloride; filter off the potassium and sodium chlorides, weigh and separate them.

*Alizarine-iron lakes:* A. W. Bull and J. R. Adams.

*Adsorption of tannin by gelatine:* A. W. Bull and J. R. Adams.

*The theory of molecular-compound formation:* V. R. Kokatnur and H. W. Stiegler. This theory is based on an observation that molecules in molecular compounds invariably contain elements that belong to 5, 6, 7, 8 groups of the periodic system. Assumptions: (1) Molecules combine through unsaturation or through latent valences of elements, especially non-metallic, belonging to aforesaid periodic groups. (2) These elements exhibit their highest capable valence and combine through these by single or double bonds. But all their valences may not be satisfied. (3) Active groups and conditions of molecules may influence this latent valency and give rise to chain-compounds and consequent isomerism.

*The diffusion of hydrogen through metals:* H. G. Deming and B. C. Hendricks. Sheet metal of 0.15 mm. thickness was clamped between heavy steel blocks in an electric furnace, the diffusion area being circumscribed on the face of each block by a pair of concentric circular knife-edges. The channel between the knife-edges in the block on the incoming side was connected to a vacuum-pump; on the outgoing side to compressed nitrogen. The diffusion was thus limited to a definite area of metal or perfectly uniform temperature, even though the blocks were never pressed against the metal tight enough to make a gas-tight joint. Aluminum is impervious to hydrogen up to its melting point. Quantitative data have been obtained for copper, iron, and other metals.

*The adsorptive property of fullers earth:* Stuart J. Bates and Alfred Stamm.

Charles L. Parsons,
*Secretary*

## AMERICAN MATHEMATICAL SOCIETY

The two hundred and seventeenth regular meeting of the American Mathematical Society was held at Columbia University, on Saturday, October 29, 1921, extending through the usual morning and afternoon sessions. The attendance included forty members of the society. Thirty new members were elected.

The following papers were read at this meeting:

*Total geodesic curvature:* J. K. Whittemore.

*On the composition of polynomials:* J. F. Ritt.

*Complete determination of polynomials whose inverses can be expressed in terms of radicals:* J. F. Ritt.

*Concerning continuous curves in the plane:* R. L. Moore.

*Concerning the relation of a continuous curve to its complement in space of three dimensions:* R. L. Moore.

*An algebraic solution of Einstein's cosmological equations:* Edward Kasner.

*On biharmonic functions:* T. H. Gronwall.

*General formulation of a combinatory method used by William Emerson and others:* L. H. Rice.

*A theorem on loci connected with cross-ratios:* J. L. Walsh.

*A generalization of the notion of covariants:* L. B. Robinson.

*Inductances of grounded circuits:* G. A. Campbell.

R. G. D. Richardson,
*Secretary*